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MEMORANDUM August 30, 2019

To: Senate Committee on the Judiciary
Attention: The Office of Senator Patrick Leahy

From: Congressional Research Service

Subject: **Comparison of Mental Health, Video Gaming, and Firearm Violence Across Eight OECD Countries**

This memorandum responds to your request for information regarding how the United States compares to other countries in firearm violence, burden of mental illness, and video game consumption. As you requested, **Figure 1** and **Figure 2** present data for eight developed nations, including the United States, on five variables: burden of mental illness, video game consumption, civilian firearm ownership, interpersonal firearm violence, and firearm self-harm. Definitions of each variable and specific data sources are listed. This memorandum briefly notes the purpose of the comparison, describes the methodology used, and displays the data in two figures.

CRS did not conduct any advanced analysis with the included data. The data are descriptive only. The juxtaposition of countries and variables displayed in this memorandum is not meant to make any determinations on the relationship between variables, including causality.

The information provided in this memorandum is customized to your request but may be of general interest to Congress. As such, all or part of this information may be used in other written CRS products. Your confidentiality as a requester will be preserved in any case.

Mental Health and Firearm Violence

The World Health Organization (WHO) has identified firearm violence as an important global public health problem.[1] Worldwide, over 250,000 people died from firearm injuries in 2016.[2] Globally, the number of firearm injury deaths in 2016 was greater than deaths from war or political conflict. The Geneva Declaration on Armed Violence and Development has estimated that annually 90% of violent deaths occur outside of conflict situations.[3]

[1] World Health Organization, *Small Arms and Global Health*, WHO Contributions to the UN Conference on Illicit Trade in Small Arms and Light Weapons July 9-10, 2001, Geneva, Switzerland, July 2001, https://www.who.int/violence_injury_prevention/publications/violence/small_arms/en/.

[2] The Global Burden of Disease 2016 Injury Collaborators, "Global Mortality from Firearms, 1990-2016," *Journal of the American Medical Association (JAMA)*, vol. 320, no. 8 (2018), pp. 792-814.

[3] Geneva Declaration on Armed Violence and Development, *Global Burden of Armed Violence 2015: Every Body Counts*,

In the United States, 39,773 persons died from firearm-related injuries in 2017.[4] Most of these deaths are due to self-harm (suicide) or interpersonal violence (homicide). During 2015-2016, suicide was the 10th leading cause of death in the United States. During that same period, homicide represented the 16th leading cause of death and the third among youths aged 10-19. Firearm injury was the underlying cause of death in 74% of all homicides and 50% of all suicides during that time.[5]

Research examining causal relationships between specific risk factors and firearm violence is often considered inconclusive or insufficient to make substantial determinations.[6] Some research has identified variables associated with firearm-related deaths. Some studies have found that society-level factors, such as government firearm regulations[7] or income inequality,[8] and individual-level factors, such as firearm ownership,[9] predict the prevalence of firearm homicides. Other factors, such as violent video game usage and mental illness, are often mentioned as possibly associated with interpersonal firearm-related violence despite mixed evidence to support these conclusions.[10] Factors found to predict firearm-related suicide also include firearm ownership.[11] While mental illness is associated with higher rates of suicide generally, the strength of the relationship between mental illness and suicide specifically by firearm is less clear.[12]

Geneva, Switzerland, May 8, 2015, http://www.genevadeclaration.org/measurability/global-burden-of-armed-violence/global-burden-of-armed-violence-2015.html.

[4] Centers for Disease Control and Prevention, National Center for Health Statistics, *Deaths: Final Data for 2017*, National Vital Statistics Reports, Volume 68, Number 9, Hyattsville, MD, June 24, 2019, p. 12, https://www.cdc.gov/nchs/data/nvsr/nvsr68/nvsr68_09-508.pdf.

[5] Scott R. Kegler, Linda L. Dahlberg, and James A. Mercy, *Firearm Homicides and Suicides in Major Metropolitan Areas - United States, 2012-2013 and 2015-2016*, Centers for Disease Control and Prevention, Morbidity and Mortality Weekly Report (MMWR), November 9, 2018, https://www.cdc.gov/mmwr/volumes/67/wr/mm6744a3.htm?s_cid=mm6744a3_w.

[6] RAND Corporation, "The Science of Gun Policy: A Critical Synthesis of Research Evidence on the Effects of Gun Policies in the United States," Santa Monica, CA, 2018, https://www.rand.org/pubs/research_reports/RR2088.html.

[7] See, for example, RAND Corporation, "The Science of Gun Policy: A Critical Synthesis of Research Evidence on the Effects of Gun Policies in the United States," Santa Monica, CA, 2018, https://www.rand.org/pubs/research_reports/RR2088.html; and Lois Lee, Eric Fleegler, and Caitlin Farrell, et al., "Firearm Laws and Firearm Homicides, A Systematic Review," *JAMA Internal Medicine*, vol. 177, no. 1 (January, 2017).

[8] See, for example, Bruce Kennedy, Ichiro Kawachi, and Deborah Prothrow-Stith, et al., "Social capital, income inequality, and firearm violent crime," *Social Science & Medicine*, vol. 47, no. 1 (July 1998), pp. 7-17; and Ted Enamorado, Luis F. Lopez-Calva, and Carlos Rodriguez-Castelan, et al., "Income inequality and violent crime: Evidence from Mexico's drug war," *Journal of Development Economics*, vol. 120 (May 2016), pp.128-143.

[9] See, for example, Michael Siegal, Craig Ross, and Charles King III, "The Relationship Between Gun Ownership and Firearm Homicide Rates in the United States, 1981-2010," *American Journal of Public Health*, November 2013, accessed at https://ajph.aphapublications.org/doi/full/10.2105/AJPH.2013.301409, and Michael Monuteaux, Lois Lee, and David Hemenway, et al., "Firearm Ownership and Violent Crime in the U.S.: An Ecologic Study," *American Journal of Preventive Medicine*, vol. 49, no. 2 (August 2015), pp. 207-214.

[10] See, for example, Justin Chang and Brad Bushman, "Effect of Exposure to Gun Violence in Video Games on Chidren's Dangerous Behavior With Real Guns," *JAMA Network Open*, vol. 2, no. 5 (May, 2019); Douglas Gentile, Paul Lynch, and Jennifer Linder, et al., "The Effects of Violent Video Game Habits on Adolescent Hostility, Aggressive Behaviors, and School Performance," *Journal of Adolescence*, vol. 27 (2004), pp. 5-22; Teena Willoughby, Paul Adachi, and Marie Good, "A Longitudinal Study of the Association Between Violent Video Game Play and Aggression Among Adolescents," *Developmental Psychology*, vol. 48, no. 4 (2012), pp. 1044-1057; Christopher Ferguson, "Video Games and Youth Violence: A Prospective Analysis in Adolescents," *Journal of Youth and Adolescence*, vol. 40, no. 4 (April 2011), pp. 377-391; Craig Anderson, Akira Sakamoto, and Douglas Gentile, et al., "Longitudinal Effects of Violent Video Games on Aggression in Japan and the United States," *Pediatrics*, vol. 122, no. 5 (November 2008), pp. e1067-e1072; Miranda Baumann and Brent Teasdale, "Severe mental illness and firearm access: Is violence really the danger?" *International Journal of Law and Psychiatry*, vol. 56 (January-February 2018), pp.44-49; and Seena Fazel, Gautam Gulati, and Louise Linsell, et al., "Schizophrenia and Violence: Systematic Review and Meta-Analysis," *PLOS Medicine*, vol. 6, no. 8, (August 11, 2009).

[11] See, for example, Michael Siegal and Emily Rothman, "Firearm Ownership and Suicide Rates Among US Men and Women, 1981-2013," *American Journal of Public Health*, vol. 106, no. 7 (July 2016), pp. 1316-1322.

[12] Deborah Stone, Thomas Simon, and Katherine Fowler, et al., "Vital Signs: Trends in State Suicide Rates - United States, 1999-

Per your request, this memorandum sought to compare the United States with selected other countries across the globe on burden of firearm violence with mental health, video game consumption, and other variables commonly proposed to relate to firearm violence. As noted, CRS did not conduct any advanced statistical analysis comparing variables. Rather, data are displayed numerically and graphically in the form of bar charts as a visual juxtaposition.

Methodology

Per your request, CRS identified international data sources for the following constructs: burden of mental illness, video game consumption, and firearm violence. Firearm violence is expressed in two categories: firearm violence (meaning violence inflicted on another person) and firearm self-harm (meaning suicide by firearm). Because some research demonstrates that firearm ownership predicts firearm violence and self-harm, it was included as a fifth variable.[13]

CRS searched for international datasets that could provide quantitative data for each variable. In some cases, more than one data source was identified. In these instances, CRS selected inclusion for this comparison based on completeness of data, methodological rigor of data collection methods, and appropriateness for this comparison. For example, both WHO and the Global Health Data Exchange (GHDx) datasets include global burden of mental illness across countries. The WHO data combine mental illness and substance abuse disorders into a single metric, while the GHDx separates these into two categories. Therefore, the GHDx data were selected for inclusion in this comparison.

Variables

The five variables included for comparison are defined as follows (with specific data sources listed):

Burden of Mental Illness

Burden of mental illness is defined here as disability-adjusted life-years (DALYs) due to mental disorders per 100,000 persons in the population. Data were obtained from the Global Health Data Exchange (GHDx). The GHDx is an international catalogue of surveys, censuses, vital statistics, and other health-related data.[14] It is operated by the Institute for Health Metrics and Evaluation (IHME)—an independent global health research center at the University of Washington.

Data for this variable were provided through the Global Burden of Disease Study 2017 (GBD 2017).[15] Mental disorders are classified in the GBD 2017 using the International Classification of Diseases (ICD) codes, for both ICD-9 and ICD-10.[16] DALYs is a metric used to quantify the health loss due to specific

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2016 and Circumstances Contributing to Suicide - 27 States, 2015," Centers for Disease Control and Prevention, *Morbidity and Mortality Weekly Report (MMWR)*, vol. 67, no. 22, June 8, 2018, pp. 617-624, https://www.cdc.gov/mmwr/volumes/67/wr/mm6722a1.htm.

[13] See, for example, footnote 5 and Matthew Miller, Steven Lippmann, and Deborah Azrael, et al., "Household Firearm Ownership and Rates of Suicide Across the 50 United States," *The Journal of Trauma: Injury, Infection, and Critical Care*, vol. 62, no. 4 (April 2007), pp. 1067-1035.

[14] The GHDx is an international catalogue of surveys, censuses, vital statistics, and other health-related data. See http://ghdx.healthdata.org/.

[15] For more information on the methodology of the Global Burden of Disease Study see a series of articles published in The Lancet available at https://www.thelancet.com/gbd.

[16] Global Burden of Disease Collaborative Network, *Global Burden of Disease Study 2017 Causes of Death and Nonfatal Causes Mapped to ICD Codes*, Institute for Health Metrics and Evaluation (IHME), Seattle, WA, 2018, http://ghdx.healthdata.org/record/ihme-data/gbd-2017-cause-icd-code-mappings.

diseases and injuries.[17] DALYs are useful for ranking disease burden due to specific causes, such as mental illnesses. The higher the DALY, the higher the years lived with ill health or disability, or lost due to premature mortality.

Video Game Consumption

Video game consumption is defined here as video gaming revenue in U.S. dollars per 100,000 persons in the population. Total revenue per country for 2018 was obtained from NewZoo via Statista.[18] Statista is a market analysis database that provides current market figures for several consumer goods in more than 200 international markets.[19] Newzoo is a leading global provider of games and e-sports analytics.[20] Its estimates are based on a combination of primary consumer research, transactional data, quarterly company reports, and census data.

To make this variable comparable to the other variables as a rate (rather than a total), CRS calculated revenue per 100,000 persons in each country by dividing total revenue by total population as determined by the World Bank Total Population index for 2017.[21]

Firearm Ownership

Firearm ownership is defined here as civilian firearm ownership per 100,000 persons in the population. Data were provided by the Small Arms Survey, an international database of information on small arms and armed violence issues.[22] Its estimates are based on data from several sources including national firearms registration statistics, general population surveys about firearm ownership, experts' estimates of civilian holdings, and analogous comparisons based on estimates for comparable countries.[23]

Firearm Violence

Firearm violence is defined here as physical violence by firearm per 100,000 persons in the population. Data were obtained from the GHDx.[24] Physical violence by firearm is classified by the GHDx data source

[17] GBD 2017 DALYs and HALE Collaborators, "Global, regional, and national disability-adjusted life-years (DALYs) for 359 diseases and injuries and health life expectancy (HALE) for 195 countries and territories, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017," *The Lancet*, vol. 392 (November 10, 2018), pp. 1859-922.

[18] Newzoo, *Leading gaming markets worldwide in 2018, by gaming revenue (in billion U.S. dollars)*, In Statista, January 31, 2019, https://www.statista.com/statistics/308454/gaming-revenue-countries/. Data available at https://newzoo.com/insights/rankings/top-10-countries-by-game-revenues/. Official totals of video gaming revenue were not available for 2017. An assumption was made that these figures did not change significantly from 2017 to 2018.

[19] https://www.statista.com/

[20] https://newzoo.com/about/

[21] The World Bank, *Population, total (2017)*, retrieved June 13, 2019 from https://data.worldbank.org/indicator/SP.POP.TOTL.

[22] Small Arms Survey, *Civilian Firearms Holdings, 2017*, Annexe, Geneva, Switzerland, June 2018, http://www.smallarmssurvey.org/weapons-and-markets/tools/global-firearms-holdings.html. Data available at http://www.smallarmssurvey.org/fileadmin/docs/Weapons_and_Markets/Tools/Firearms_holdings/SAS-BP-Civilian-held-firearms-annexe.pdf.

[23] Aaron Karp, Small Arms Survey, *Estimating Global Civilian-Held Firearms Numbers*, Briefing Paper, Geneva, Switzerland, June 2018. Small arms include revolvers and self-loading pistols, rifles and carbines, assault rifles, sub-machine guns, and light machine guns, http://www.smallarmssurvey.org/weapons-and-markets/tools/global-firearms-holdings.html.

[24] The GHDx is an international catalogue of surveys, censuses, vital statistics, and other health-related data. See http://ghdx.healthdata.org/.

using ICD-9 and ICD-10 codes[25] and includes assault by a firearm discharge and completed homicide by firearm.[26] It does not include firearm injury due to terrorism, war operations, or legal intervention.

Firearm Self-Harm

Firearm self-harm is defined here as self-harm by firearm per 100,000 persons in the population. Data were obtained from the GHDx. Intentional self-harm by firearm is classified by the GHDx data source using ICD-9 and ICD-10 codes.[27] Self-harm by firearm includes intentional self-harm by a specified (e.g., handgun, rifle) or unspecified firearm.[28] It does not include unintentional firearm injury.

Countries

Complete data for each of these variables are not available for every country worldwide. CRS selected countries for inclusion in this comparison roughly based on the following criteria: (1) completeness of data available for all five variables; (2) membership in the Organisation for Economic Co-operation and Development (OECD)[29]; and (3) similar global rank in one of the variables included (e.g., gaming revenue, civilian firearm ownership).

The eight countries included in this comparison were selected to provide as much geographic diversity as possible (i.e., four different continents are represented). As noted, data on firearm violence from the GHDx do not include violence inflicted as part of a military or political conflicts. These data represent civilian violence only.

Results

Eight countries that met the inclusion criteria were selected for comparison: Australia, Canada, France, Germany, Japan, Spain, Sweden, and the United States.[30] Data for all variables are displayed in alphabetical order by country in **Figure 1**. **Figure 2** lists each country by order of firearm violence, starting with the country with the highest rate of firearm violence per 100,000 in the population.

Limitations

The data included here are descriptive only. The juxtaposition of countries and variables displayed in this memorandum is not meant to make any determinations on the relationship between variables, including causality. Any interpretations based on the information provided should be done with caution.

Additionally, there may be several limitations with the data presented. For instance, complete data were not available for every country. Therefore, the countries selected for inclusion were not randomly

[25] Global Burden of Disease Collaborative Network, *Global Burden of Disease Study 2017 Causes of Death and Nonfatal Causes Mapped to ICD Codes*, Institute for Health Metrics and Evaluation (IHME), Seattle, WA, 2018, http://ghdx.healthdata.org/record/ihme-data/gbd-2017-cause-icd-code-mappings.

[26] World Health Organization (WHO), *International Classification of Diseases and Related Health Problems (ICD) 10th Revision*, 2016, https://icd.who.int/browse10/2016/en.

[27] Global Burden of Disease Collaborative Network, *Global Burden of Disease Study 2017 Causes of Death and Nonfatal Causes Mapped to ICD Codes*, Institute for Health Metrics and Evaluation (IHME), Seattle, WA, 2018, http://ghdx.healthdata.org/record/ihme-data/gbd-2017-cause-icd-code-mappings.

[28] WHO, *ICD-10*, 2016.

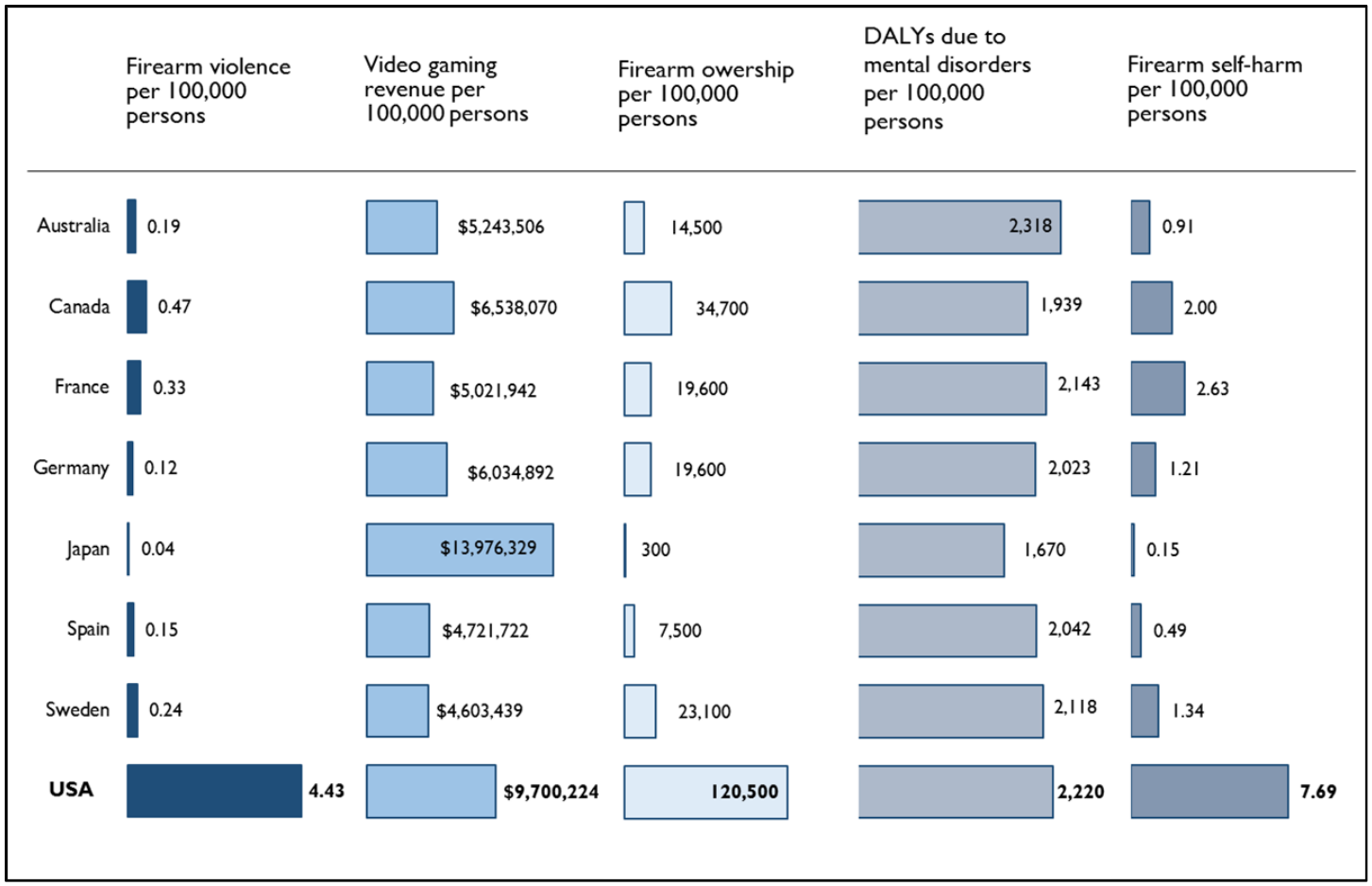
[29] https://www.oecd.org/about/.

[30] This list is not exhaustive. The cutoff at eight countries was made for brevity. Other countries meeting the inclusion criteria were Italy, Mexico, Netherlands, Republic of Korea, and Turkey, among others.

sampled. These countries may also vary in other relevant indices that affect firearm violence rates, such as firearm ownership laws. These countries may differ in other ways that also affect the variables included, such as in economic and health care systems.

The datasets for each variable may contain their own limitations also. For example, the Small Arms Survey notes several challenges in accurately estimating civilian firearms holdings due to concealment, illicit activity, or registration differences between countries. Also, the video game revenue data used here includes all video games, not limited to violent or *first-person shooter* games.[31]

Figure 1. Comparison of Mental Health, Video Gaming, and Firearm Statistics Across Eight OECD Countries: Alphabetical by Country



Source: CRS analysis from the following sources, by variable:

Firearm violence: Institute of Health Metrics and Evaluation, Global Health Data Exchange, Seattle, WA, http://ghdx.healthdata.org/.

Video gaming revenue: Newzoo, *Leading gaming markets worldwide in 2018, by gaming revenue (in billion U.S. dollars)*, In Statista, January 31, 2019, https://www.statista.com/statistics/308454/gaming-revenue-countries/. Data available at https://newzoo.com/insights/rankings/top-10-countries-by-game-revenues/.

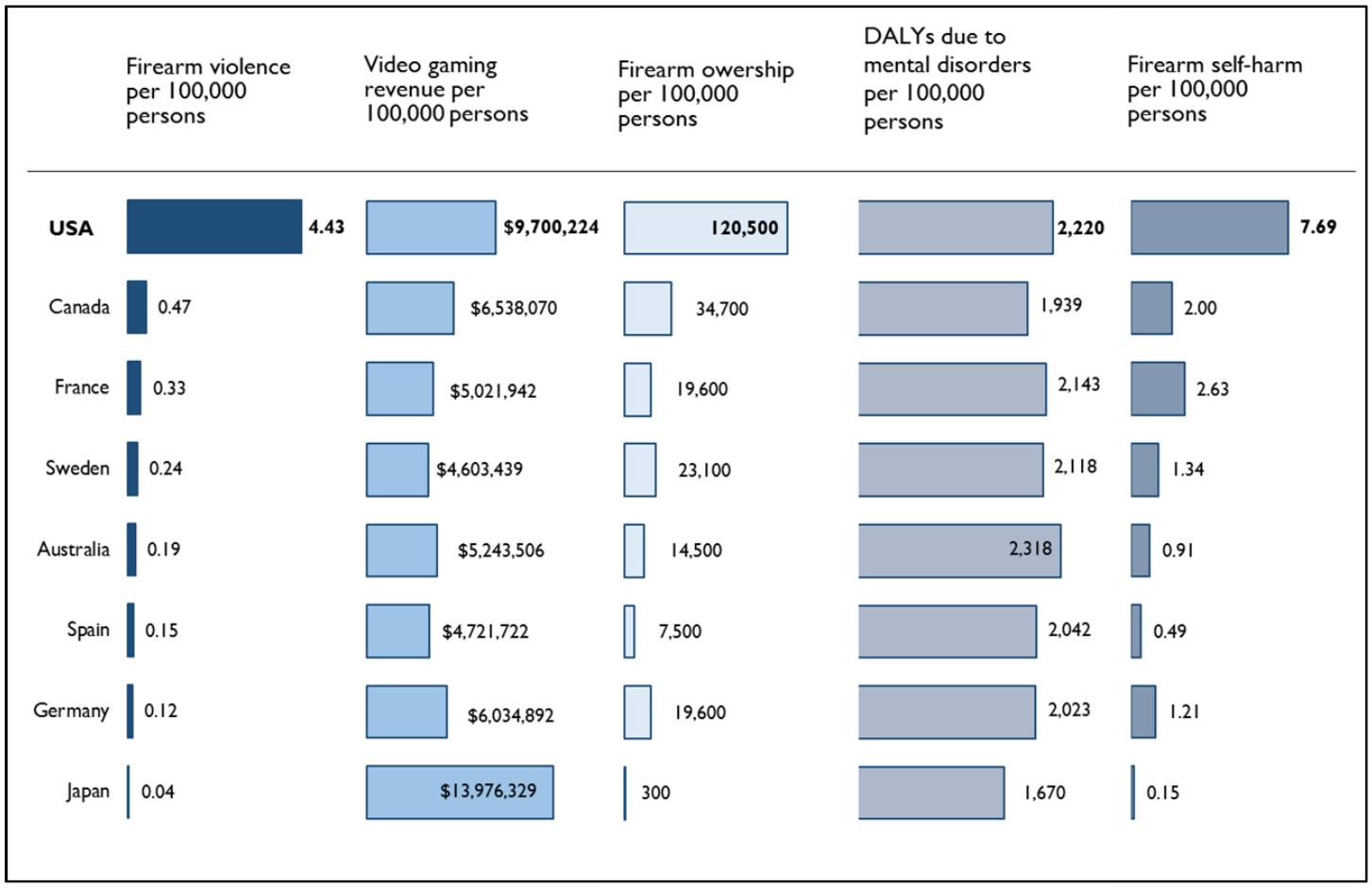
[31] *First-person shooter* games are defined as "a shooter game in which the game is displayed from the first-person perspective. Also sometimes called POV (point of view) shooter and, in Europe, an egoshooter." From Ernest Adams and Andrew Rollings, *Fundamentals of Game Design*, Pearson: London, UK (2010).

Firearm ownership: Small Arms Survey, *Civilian Firearms Holdings, 2017*, Annexe, Geneva, Switzerland, June 2018, http://www.smallarmssurvey.org/weapons-and-markets/tools/global-firearms-holdings.html. Data available at http://www.smallarmssurvey.org/fileadmin/docs/Weapons_and_Markets/Tools/Firearms_holdings/SAS-BP-Civilian-held-firearms-annexe.pdf.

DALYs due to mental disorders: Institute of Health Metrics and Evaluation, Global Health Data Exchange, Seattle, WA, http://ghdx.healthdata.org/.

Firearm self-harm: Institute of Health Metrics and Evaluation, Global Health Data Exchange, Seattle, WA, http://ghdx.healthdata.org/.

Figure 2. Comparison of Mental Health, Video Gaming, and Firearm Statistics Across Eight OECD Countries: Ranked by Firearm Violence



Source: As per **Figure 1**.